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Activities of The Experiment Station In Production Research

Timing of Oil and Parathion Sprays For Purple Scale Control

Sub-Soil Drainage As A Factor In The Spread Of The Burrowing Nematode

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Effectiveness Of The Pull And Treat Method

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Chairman of the Board of Directors of the Florida Citrus Exposition, is one of the state's younger citrus executives, his interests covering growing, packing of fresh fruit, processing, concentrates and by-products. He served almost ten years as president of the Florida Citrus Exposition organization before assuming the position of board chairman.

VOL. 37 — NO. 2 FEBRUARY, 1956 BARTOW, FLORIDA

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R. M. Pratt

Citrus Insect Control

R. B. Johnson

For February 1956

W. L. THOMPSON,
R. M. PRATT
R. B. JOHNSON*
Florida Citrus Experiment Station, Lake Alfred

W. L. Thompson

During the past month severe firing, mesophyll collapse, and leaf drop occurred in groves in all citrus areas. Where injury was most severe, the trees literally had the appearance of having been scorched by a fire and dead leaves and bare twigs became most evident in the tops and on the south and east sides of the trees. This wide-spread damage is attributed to low soil moisture and drying winds and occurred when the leaves lost water faster than the roots could supply it. In many cases, leaf injury caused by purple mite and rust mite was an aggravating factor. Where this was the case, the firing and leaf drop occurred either when the mites were present, or the symptoms appeared during unfavorable weather even after the mites had disappeared or had been controlled. Unfavorable rootstocks and previous injury of roots by a high water table were other contributing conditions.

Where the leaves have died on the trees, the twigs will usually be found to have died back six inches or more. At this time it is not possible to say how many of the twigs that are still green will die. If new growth begins soon, there will be less die-back than if growth is delayed by cold or dry weather. In any case the twigs that die will become sources of melanose spores, and the melanose problem may be severe this year if rains occur when leaves and young fruits are susceptible to infection.

The purple mite activity level was low through January, even though the damage caused was out of proportion to the number of mites present. There will be some increase in February, but the general level will be lower than average through the spring months. Rust mite activity was high, but will decline through February.

Purple scale activity was low in January. There will be an increasing trend starting about the end of January and continuing until mid-April, but the population level will be below average.

Red scale activity was fairly high in January, but the level is expected to be lower in February, with an increasing trend starting at the end of the month.

Six-spotted mite infestations are hard to find and will not be important this year. There will be some increase in infestations in April and May. Mealybug infestations will be lower than average this spring but control should not be ignored in groves where this pest has been troublesome.

If the spring flush of growth is uniform and matures rapidly, aphid populations will be low. If the period of new growth is irregular and prolonged, the average infestation will be higher.

Scale and Mite Activity by Districts*

District	Purple Scale	Red Scale	Purple Mite	Rust Mite on leaves	Rust Mite on fruit
West Coast	3.51	2.35	1.00	2.00	1.90
Indian River	3.19	3.66	1.53	1.15	1.09
Upper East Coast	3.08	1.13	1.20	2.40	2.00
Gainesville	2.58	.17	.34	.67	0
Orlando	2.57	2.27	.76	.64	.52
Brooksville	3.98	1.26	1.62	1.92	1.86
Ridge	4.03	3.66	1.64	1.73	1.58
Bartow	2.96	2.18	.63	3.26	2.67
State Average	3.36	2.77	1.17	1.52	1.35
Last Year	3.11	1.77	1.69	1.38	1.37

*Third week in January. Activity is computed from populations, amount of hatching of scales, and number of groves with increasing or decreasing infestations. Activity is considered high if above 4.0 for purple scale, 3.0 for red scale, and 1.5 for mites.

SPRAY PROGRAM

February is expected to be a difficult month for the spray program because of the presence of new growth. Although new growth is already present in many groves, a few days of warm weather should result in a marked increase in the amount. This will mean that all spraying should be kept to a minimum to prevent mechanical injury to succulent foliage. It will also mean that DN Dry Mix should not be used at all and that relatively safe materials such as neutral copper and zinc compounds, parathion, oil and lime-sulfur may also cause some injury. A good safe rule to follow during February is to spray as little as possible.

Scale Control: Except where infestations of purple or Florida red scales are very severe, control measures should now be delayed until the post-bloom period. There are two reasons for this. Although a fairly high percentage of Florida red scale is in the first or second stage and thus easy to control, the purple scale situation is not so favorable. Also, the danger of damaging new foliage is greater than the potential damage from scale at this time. Where scale control is necessary before post-bloom or where sprays must be applied for other reasons, parathion or malathion may be included. These two materials are safer than oil emulsion in relation to possible injury from cold weather and may be used with any of the materials recommended for mite control and for nutritional purposes. Use 15 percent parathion at 1 to 1.7 pounds or 25 percent malathion at 3 to 5 pounds for light to heavy infestations.

Mite Control: Both purple mite and rust mite are more likely to be injurious before post-bloom than scale insects. More attention should thus be paid to mite control if further leaf drop and possibly more dead wood is to be prevented.

As pointed out above DN Dry Mix should not be used on succulent foliage. The safer materials for purple mite control are EPN-300 at 1 pound, aramite at 2 pounds, and

(Continued on page 21)

* Written January 25, 1956. Reports of surveys by Harold Holtsberg, Cocoa; J. W. Davis, Tavares; K. G. Townsend, Tampa; T. B. Hallam, Avon Park; and L. M. Sutton, Lake Alfred.

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Grapefruit Joins To Help Put The Squeeze On Polio

Florida Citrus Mutual announced recently it has joined hands with the State and National Polio Foundation to "help put the squeeze" on polio in a special fund-raising campaign held throughout the state on January 20.

Robert W. Rutledge, Mutual General Manager, said Mutual, Golden Gift, Inc., of DeLand, and Fruit Industries, Inc., Bradenton contributed grapefruit juice in especially designed eight ounce cartons which was used during the one-day drive.

"These cartons were made available to all Florida County Polio chairmen and was given away to each contributor to the March of Dimes," he said.

Rutledge said Dr. Hart E. Van Riper, medical director of the National Foundation for Infantile Paralysis lent his support to the grapefruit project. Dr. Van Riper, medical director of Jackson Memorial Hospital at Miami before joining the staff of the National Foundation is currently in Florida to aid in every way possible with the polio campaign.

Rutledge said the special grapefruit carton was designed to show a child crippled with polio on one panel of the carton. Another panel tells a portion of the polio story with the other two panels given to Mutual and the contributing processors.

The program for "Putting the Squeeze on Polio with Grapefruit Juice" came about as a result of a request from Edward D. Whittlesey, March of Dimes Publicity Chairman from Florida State University, Tallahassee.

Also cooperating were County Chairmen from the entire state who administered the drive in their particular counties and who gave away the grapefruit juice to all who contributed. Working with the county chairmen were various civic organizations, Boy Scouts, Girl Scouts and other young peoples groups.

Withertip and anthracnose are more prevalent in the Fort Pierce area than at any other time in the history of the industry, says Chas. D. Kime, Saint Lucie County Agent. Large shortage in rainfall is believed responsible, Kime says, for the leaf drop, stem-end rot of fruit and increased injury by spiders and mites.

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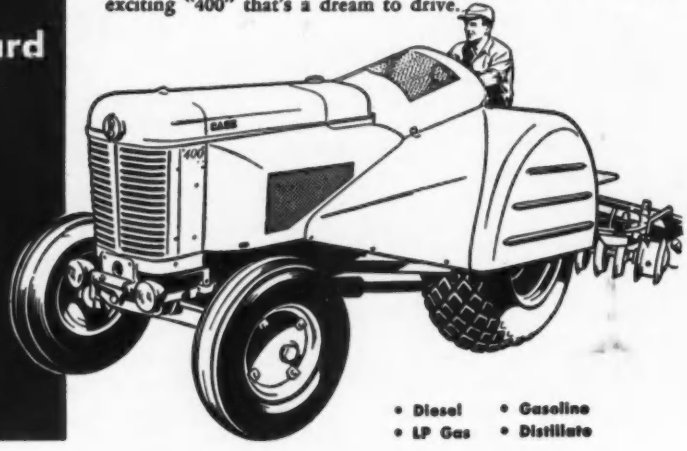

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Florida Citrus Exposition --- The World's Greatest, Winter Haven, Feb. 13-18

JACK M. BERRY,

President of the Florida Citrus Exposition, is an extensive citrus grower in his own right, and for many years has operated a big fruit brokerage business.

With the emphasis on the production of top quality fruit the 1956 Florida Citrus Exposition fresh fruit contest will have as the top award a beautiful silver trophy, suitably engraved provided by the Florida Agricultural Research Institute located at Winter Haven.

Departing from the usual custom, all commercial packed citrus entered in the contest, to be run coincidental with the Exposition, Feb. 13-18, will compete on a state-wide basis with no division by citrus commission districts.

Florida Citrus Mutual, cooperating with the show, in staging both the fresh fruit contest and the program for "Fresh Fruit Day" on Thursday, Feb. 16, said that first, second and third awards wouud be made in each main variety of citrus, with five blue ribbons for runners-up in oranges, grapefruit and tangerines.

The FAIR trophy will be a "sweepstakes" or "best in show" award for the best commercial pack of any variety. Growers who enter fruit in the contest can use any type container, wirebound or standard box, basket or paperboard, now on the approved list of the Florida Citrus Commission.

W. E. RYNERSON,

Secretary of the Florida Citrus Exposition, is a veteran newspaperman and has been co-owner and publisher of the Winter Haven News-Chief for many years.

JAY WHITAKER,

Treasurer of the Florida Citrus Exposition, is Winter Haven plant manager of the Swift & Co., fertilizer division and is closely associated with the Florida citrus industry.

PHIL LUCEY,

General Manager of the Florida Citrus Exposition, nas held that position since the show was resumed following World War II. He has had extensive experience in the Exposition field.

Hagan Parrish, Mutual field man, coordinating the fresh fruit activities of the Exposition, said he anticipated a record number of individual entries in the contest. Full details will be made public and the contest will be open to all citrus growers regardless of Mutual membership.

Jack M. Berry, president of the Exposition, said arrangements have been made to provide the 1956 Florida Citrus Queen to be named during the week of the show, a two weeks tour of Europe, going overseas by KLM plane, after traveling to New York from Florida via Eastern Air Lines. She can select her own com-

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panion for the trip.

Phil E. Lucey, general manager of the Exposition, said at least 25 to 30 entries are expected for the queen contest. The winner, in addition to the Euporpean trip and a lion's share of some $10,000 worth of other prizes, will get a one-year contract with the Florida citrus Commission, carrying a $200 monthly retainer, to aid in promoting Florida citrus on radio and TV and at conventions and other big gatherings over the nation.

Day by Day Program

MONDAY

Children's Day — Queen Contest Preliminaries

9:00 A. M. Gates open

9:30 A. M. Parade

11:00 A. M. "Wish Upon A Star" N. B. C. Network Broadcast with Eddie Dunn from Nora Mayo Hall.

2:30 P. M. Hippodrome Acts, Lake Silver Amphitheater

7:00 P. M. Hippodrome Acts, Lake Silver Amphitheater

7:30 P. M. Florida Citrus Queen Contest Preliminaries — Amphitheater

10:30 P. M. Fireworks display in front of Amphitheater

TUESDAY

By-Products Day — Queen Contest Preliminaries

10:00 A. M. Gates Open

11:00 A. M. "Wish Upon A Star" N. B. C. Network Broadcast — Nora Mayo Hall

12:30 P. M. Luncheon*

2:30 P. M. Hippodrome Acts, Lake Silver Amphitheater

7:00 P. M. Hippodrome Acts, Lake Silver Amphitheater

7:30 P. M. Florida Citrus Queen Contest Preliminaries — Amphitheater

10:30 P. M. Fireworks display in front of Amphitheater

WEDNESDAY

Queen Contest Finals — Mayo Luncheon — Coronation Ball

10:00 A. M. Gates Open

11:00 A. M. "Wish Upon A Star" N. B. C. Network — Nora Mayo Hall

12:00 P. M. Nathan Mayo Luncheon — Haven Hotel*

2:30 P. M. Hippodrome Acts, Lake Silver Amphitheater

7:00 P. M. Hippodrome Acts, Lake Silver Amphitheater

7:30 P. M. Florida Citrus Queen Contest Finals — Amphitheater

9:00 P. M. Coronation Ball — Nora Mayo Hall*

10:30 P. M. Fireworks display in front of Amphitheater

THURSDAY

Florida Citrus Mutual Day — Fresh Fruit Day

10:00 A. M. Gates Open

(Continued on page 22)

Effectiveness Of The Pull And Treat Method

For Controlling The Burrowing Nematode On Citrus . . .

R. F. SUIT, E. P. DuCHARME, AND TROY L. BROOKS
FLORIDA CITRUS EXPERIMENT STATION, LAKE ALFRED

AT MEETING FLORIDA STATE HORTICULTURAL SOCIETY

R. F. SUIT

E. P. DuCHARME

The State Plant Board is now engaged in an elaborate program to check the ravages of citrus spreading decline. Since the pull and treat method is the basis of this program, it seems desirable to bring this audience up to date on the experimental evidence for the feasibility and effectiveness of the method.

The pull and the treat method, first suggested by Suit and Ford (1) in 1950, consists of removing all the diseased trees within an area, together with trees in four adjacent rows and then thoroughly fumigating the soil. Experimental work with the method was started in seven groves in 1951, two years before the burrowing nematode, **Radopholus similis** (Cobb) Thorne, was proved to be the cause of spreading decline (2). A preliminary evaluation of this experiment work was presented in 1954 (4).

During the spring of 1951 the spreading decline areas in each of seven groves were determined by inspection of the trees for visible symptoms and the affected area indicated on a map. The area on the map was then enlarged, as suggested in 1950 (1), by drawing a line to enclose the next four trees outward from the affected area. All trees encircled by the line were pulled and burned within the area. Following this, the soil was plowed, most of the roots picked up, and the land leveled by discing. The soil was then treated with D-D Soil Fumigant at the rate of 40 gallons per acre with a machine designed for vegetable land; consequently the D-D was injected at a depth of only six to eight inches. This machine also had difficulty in making uniform application when Bermuda grass or a certain amount of trash was present in or on the soil. Treatment of the areas was completed by July 1, 1951, and all the areas were replanted before March 1, 1952. Three years later, during the spring and summer of 1955, root samples from each reset tree in the treated areas and from the mature trees around the margin were examined for burrowing nematode. The number of trees removed and reset, the number of resets infested, and the condition of the margin of the treated area after three years are given in Table 1. It is to be noted that although the groves were pulled and treated only on the basis of the visible symptoms of decline with an arbitrary four tree margin, spreading decline was arrested in five of the seven groves. In the two groves where the decline was not arrested, the four tree margin had not encircled the infested area.

TROY L. BROOKS

Grove 1 contained 60 acres of Marsh grapefruit and Valencia oranges and had a spreading decline area at the south end. None of the reset trees were infested when sampled. However, five mature trees on the west side of the area showed infestation in 1955. There are only three rows of trees to the edge of the grove at this place, and sufficient trees will be removed to eliminate the infestation.

Grove 2 is a 40-acre block of Valencia oranges, which had a corner of the grove around a tenant house diseased. Only two of the reset trees were found to be infested in 1955. These two trees were adjacent to the house yard, which had not been treated and from which the original infestation came. The margin of the pulled and treated area is free of spreading decline.

Grove 3 is an 80-acre block of grape-

fruit and Valencia oranges, which had an area of spreading decline in the center. In 1955, only one reset tree was found infested. The soil around this tree was treated with D-D by a hand injector to kill the tree and eliminate the infestation. The margin of the pulled and treated area is free of spreading decline.

Grove 4 is a 40-acre block of Valencia oranges which had a diseased area along part of the south side and in the southwest corner. The lawn and shubbery around the tenant house, which was in the area, was also removed and the entire pulled area treated up to the house foundation. Four of the reset trees showed burrowing nematodes when sampled in 1955 but none were adjacent to the house. The soil around these trees was treated with D-D by a hand injector to eliminate the infestation. In December 1953, 15 mature trees on the north side of the treated area was found to be infested. A number of trees sufficient to encompass the infested area were removed in the spring of 1954 and that area treated. This additional area was reset in February 1955.

Grove 5 is a 15-acre block of grapefruit and Valencia oranges that had an area of spreading decline in the northeast corner. There were nine reset trees in two rows along the north side that showed infestation. These rows were adjacent to a street with a curbing and with a heavy growth of Bermuda grass so it would appear that the soil treatment was not proprly done in that section. The margin of the pulled and treated area is free of spreading decline.

Grove 6 is a 100-acre block of Valencia oranges, which had an area of spreading decline near the center. There were 41 reset trees that were infested. These trees were scattered throughout the treated area but none were within two rows of the mature trees. In this case either the treatment was only partially effective or the nursery stock used for resetting was infested. The mature trees around the margin of the pulled and treated area are free of spreading decline.

Grove 7 is a 15-acre block of Valencia oranges in which the disease was in the west end. The grove was odd shaped so that five rows connected an area of about two acres on the west to the rest of the grove. The five rows were removed and the soil treated but citrus was not replanted. The east portion of the grove is free of spreading decline.

These experiments point out several facts. If sufficient trees are removed to encircle the infested area, spreading decline can be arrested. Soil treatment is effective if the fumigant is properly applied. Treated soil can become reinfested from an adjacent homesite. That treated soil may become reinfested by resetting the area with diseased nursery stock is, of course obvious.

Table 1. Results of the Pull and Treat Method in Seven Groves Treated in 1951.

Grove No.	Acres in Grove	Number of trees pulled and reset	Number of reset infested 1955	Condition of Margin-1955
1	60	199	0	5 trees infested on west side
2	40	82	2	Not infested
3	80	418	1	Not infested
4	40	349	4	Dec. 1953-15 infested trees on north side. Repulled spring 1954.
5	20	178	9	Not infested
6	100	336	41	Not infested
7	15	48 pulled	none reset	Not infested

Each year since 1951, the pull and treat method has been used on an experimental basis in a number of additional groves. From the preliminary observations made to date the results appear to be satisfactory. In 1953, after the burrowing nematode had been established as the cause of the decline, some improvements were made in the treating procedure. The fact that the nematode was found at depths as great as 12 feet led to increasing the rate of D-D application to 60 gallons per acre (3). This higher rate also provides a margin of safety should the machine fail to inject uniformly. Heavier soil treatment machines, which could inject the D-D at a depth of 12 inches in the soil, were built by 1954. These were equipped with large coulters to cut grass and trash ahead of the injection shanks. In two experiments conducted during the spring of 1955, where D-D was injected at a depth of 12 inches on 18 inch centers, the fumigant had penetrated the soil to a depth of 11 feet to the clay layer dept of 11 feet to the clay layer

In each of the seven experiments reported herein the grove owner was furnished a map of his grove showing that portion to be removed and treated. The removal of the trees and the soil treatment was done by the owner following our directions. Thus the experiments were conducted on a practical basis. Since the pull and treat method controls spreading decline under these conditions, other growers should also be able to do it if they are provided with a map showing the trees to be removed. Under close supervision the pull and treat method should be very effective.

In view of the experience obtained with the pull and treat method, a proper procedure can be established to insure satisfactory results, as follows:

1. Map grove to show extent of visible symptoms of spreading decline.

2. Determine area actually infested by samplying in advance of visibly diseased trees for burrowing nematodes.

3. Draw a line on the map at least two trees beyond the last positive finding of the nematode to indicate trees to be removed. The two trees are considered as a safety margin to insure that the infested area is encircled. This line on the map may be more than four apparently healthy trees ahead of those showing spreading decline, depending upon the inlicated rate of movement of the nematode in that particular area.

4. Remove trees in that part of the grove indicated on the map. The map used should have been completed within 30 days of the time of tree removal. Remove grass, shrubbery, and trees around any sheds, barns, houses or buildings in the area.

5. Burn trees within the pulled area. Do not drag trees to another location.

6. Plow land as deeply as possible to cut and loosen roots.

7. Collect as many of the roots as possible and burn in the area.

8. Level land by discing and draging.

9. Treat soil with D-D Soil Fumigant at 60 gallons (600 pounds) per acre injected at a depth of 12 inches. If buildings are present, treat up to the foundation. Avoid skips in fumigation by close observation of the machine during application.

10. Do not replant to citrus for two years. This interval will allow time for re-check of the trees at the margin to be sure that the infested area was encircled and if not, to remove whatever additional trees are necessary.

11. During the two year period, no hosts of the burrowing nematode should be allowed to grow in the treated area. This will allow time for any burrowing nematodes, not killed by fumigation, to die out. Hairy indigo or **Crotalaria spectabilis** could be grown for a cover crop during the interval.

If this procedure is properly executed, the results to date indicate

(Continued on page 23)

Timing Of Oil And Parathion Sprays For Purple Scale Control

In The Southern Indian River Area

W. T. LONG

W. T. LONG, H. J. REITZ AND
W. L. THOMPSON
FLORIDA CITRUS EXPERIMENT
STATION, LAKE ALFRED

AT MEETING FLORIDA STATE
HORTICULTURAL SOCIETY

W. L. THOMPSON

This paper presents results of a scale control experiment conducted at the Indian River Field Laboratory grove near Ft. Pierce over the past four years. The first objective was to determine for the Indian River area the most advantageous period of the year for a single annual scalicide application. Thompson (2) has obtained this information for Central Florida, and the recommended June-July application period has been widely adopted throughout the State. However, observations prior to 1951 led to belief that June-July recommendation might profitably be modified for Indian River conditions.

The second objective was to compare the effectiveness of oil and parathion. The merits of parathion also have been conclusively demonstrated by Thompson et al (3), but parathion use was limited in the Indian River area when this experiment began. Use has increased substantially since then.

The timing results obtained have been conclusive but at variance with standard practice in certain respects, while the parathion-oil comparison substantiates previously reported results. The experiment has not yet been completed, but the information already obtained on timing is of considerable practical value.

MATERIALS AND METHODS

The experiment was conducted on Valencia orange trees on sour rootstock, planted in 1940. The plots included soils of both Manatee and Parkwood series, but the trees were fairly uniform in size. During the course of the experiment the trees received a high level of fertilization.

There were 13 main timing treatments in the experiment. Twelve of the main timing treatments each received a thorough application of a scalicide on the first comparatively windless day of a different month throughout the year. The thirteenth main treatment received scalicides in both post-bloom and summer periods, thus receiving two applications each year. Also, there was a supplementary treatment receiving all regular sprays except a scalicide. This treatment was included to demonstrate the value of a scalicide. Each main treatment plot was further split into two halves, one receiving oil and the other parathion. The experiment was replicated six times. Experimental data were analyzed statistically by split plot anaylsis of variance, with spray dates the main plot factor, and scalicides the subplot factor. The first application was made December 1, 1951.

H. J. REITZ

All spray applications were made by use of a conventional high pressure sprayer equipped with Boyce-type guns. Oil was applied at 1.3 percent and parathion at two lbs. of 15 percent material per 100 gallons, except that after November 1954 parathion was applied at 1.7 lbs. per 100 gallons. Mites were controlled by general sprays as necessary.

RESULTS

Scale and mealybug populations and their control. — Immediately before spraying any plots, the percentages of scale infested leaves was determined. So few Florida red scale were found that they can be ignored in this paper. The data showing prespray population of purple scale are presented in Fig. 1. These data show that high infestations of purple scale were present by June of each year. Delay of the scalicide application until the standard June-July period did not prevent scale populations from reaching damaging levels, nor did

applications in summer reduce that high population to a very low level. Once a high level is attained, two applications are nearly always necessary to obtain low level.

There was little overall difference in scale control with oil and parathion. After operation of the experiment for one year, the parathion plots usually had slightly higher scale populations just before spraying than did the oil plots. However, the percentage reduction in infested leaves was greater with parathion than with oil in 26 out of 36 cases during 1952 through 1954. Parathion was more effective than oil in 22 out of 24 cases during the warm season between May 1 and December 1, but only in 4 out of 12 cases when applied in the colder season from January 1 through April 1. The actual proportion of scale infested leaves one month after spraying was lower in parathion plots than in oil plots in 32 of 42 cases during 1952 to 1953. Thus, oil excelled parathion only in a few cases and these were in the period January through July.

Another comparison of oil and parathion was based on (Table 1) scale counts made in all plots in January 1953 and Januray 1954. The January 1953, counts showed appreciably more infested leaves in oil plots than in parathion plots, especially in the plots sprayed in August through December. The January 1954 counts did not show any difference between oil and parathion.

Mealybugs were prevalent in early 1954. On May 14, 1954 counts were made of the number of egg masses present on certain area of the trunk and scaffold branches of each tree. Results (Table 1) show the great superiority of parathion, especially when applied in the period November through April.

Tree appearance.—At the beginning of the experiment on December 1, 1951 the scale population was less than 10 percent, all plots having been sprayed for scale during the previous four months. The trees had been recently pruned, and the density of foliage was fairly good. At the end of 1952 the trees sprayed in the winter months appeared to be somewhat more dense in foliage than trees sprayed at other times. In 1953 the trees sprayed in the period December through May were clearly more dense in foliage than others. Trees sprayed with parathion had denser foliage than trees sprayed with oil, particularly when the sprays were applied in the fall. In August 1954, a foliage density scoring system was devised. Individual trees were indexed as follows: 1 — foliage density sufficient to obscure scaffold branching; 2 — foliage density not sufficient to obscure scaffold branches, but dense enough to obscure the tree beyond; and 3— foliage density not sufficient to obscure the tree beyond. This system covers a wide range of tree conditions, and proved to be braced enough to serve as an accurate and rapid method void of bias. Table 2 shows the average

Table 1. Effect of Scalicide and Time of Spraying on the Relative Infestation of the Trees by Mealybugs and Purple Scales

Approximate time of spraying	Mealybug egg masses per tree May 14, 1953		Percent purple scale infested leaves			
			January 1953		January 1954	
	Parathion	Oil	Parathion	Oil	Parathion	Oil
Jan. 1	0.0	6.5	38	40	9	12
Feb. 1	0.2	3.5	53	54	26	29
March 1	0.5	7.5	36	41	32	42
April 1	0.3	7.3	36	25	23	24
May 1	3.7	10.0	27	36	26	22
June 1	6.8	9.2	34	35	28	24
July 1	6.5	10.3	35	30	22	15
Aug. 1	6.7	7.7	17	39	13	12
Sept. 1	2.8	7.7	11	33	4	10
Oct. 1	3.3	12.5	1	22	4	6
Nov. 1	0.7	7.8	13	23	10	2
Dec. 1	0.8	4.0	8	13	0	0
Postbloom and Summer	0.0	6.2	16	19	12	10
Av. all times	2.5	7.8	25	32	16	16
No scalicide	7.7		46		23	
"F" Values						
Time of spraying	3.61**		7.03**		34.5**	
Scalicides	69.32**		17.44**		0.04	
Time x Scalicide Interaction	1.10N.S.		3.06**		1.83N.S.	

Ns — Not significant
* — Significant at 5 percent level
** — Significant at 1 percent level

Table 2. Effect of Scalicide and Time of Application on the Density of Foliage and Amount of Dead Wood in Trees

Approximate time of spraying	Foliage density index, Av. of Aug. 1954 and Aug. 1955. (a)		Pounds of dead wood per tree, total 1953-54 and 1954-55	
	Parathion	Oil	Parathion	Oil
Jan. 1	1.8	2.0	9.1	11.5
Feb. 1	1.7	2.3	10.4	13.8
March 1	1.6	1.8	8.2	13.9
April 1	1.5	2.2	10.6	15.4
May 1	1.9	2.2	11.7	14.4
June 1	2.1	2.6	16.9	18.9
July 1	2.6	2.8	23.2	19.8
Aug. 1	2.3	2.6	21.3	23.0
Sept. 1	2.0	2.7	15.9	19.1
October 1	1.7	2.3	8.8	15.3
Nov. 1	1.9	2.3	10.4	14.3
Dec. 1	1.7	2.1	12.2	16.2
Postbloom & summer	1.3	2.3	6.5	12.6
Av. all times	1.8	2.3	12.4	16.1
No scalicide	2.9		19.1	
"F" Values				
Time of spraying	5.06**		9.28**	
Scalicides	101.2**		100.79**	
Time x Scalicide Interaction	2.05*		4.58**	

* — Significant at 5 percent level
** — Significant at 1 percent level
(a) Index of 1 indicates highest density, 3 indicates lowest density (see text)

Table 3. Effect of Scalicide and Time of Spraying on the soluble Solids Content of the Fruit Juice.

Approximate time of spraying	Percent soluble solids			
	Size 200 fruit sampled March 10, 1954		Random fruit sample taken March 21, 1955	
	Parathion	Oil	Parathion	Oil
Jan. 1	11.8	11.4	12.8	12.5
Feb. 1	11.6	11.5	12.8	12.2
March 1	12.1	11.9	13.2	13.1
Apr. 1	11.8	11.7	12.8	12.5
May 1	11.9	11.3	13.1	12.6
June 1	11.4	11.1	12.9	12.5
July 1	11.1	10.9	12.8	12.7
Aug. 1	11.8	11.0	12.6	12.2
Sept. 1	11.3	11.1	12.7	12.1
Oct. 1	11.8	11.3	12.7	12.5
Nov. 1	11.8	11.9	13.0	12.7
Dec. 1	11.9	11.7	13.0	12.7
Postbloom and summer	11.4	10.8	12.8	12.0
Av. all times	11.7	11.4	12.9	12.5
No scalicide	11.6		13.0	
"F" Values				
Time of spraying	3.00**		3.35**	
Scalicides	21.34**		34.10**	
Time x Scalicide Interaction	1.00 N.S.		0.87 N.S.	

N. S. — Not significant
* — Significant at 5 percent level
** — Significant at 1 percent level

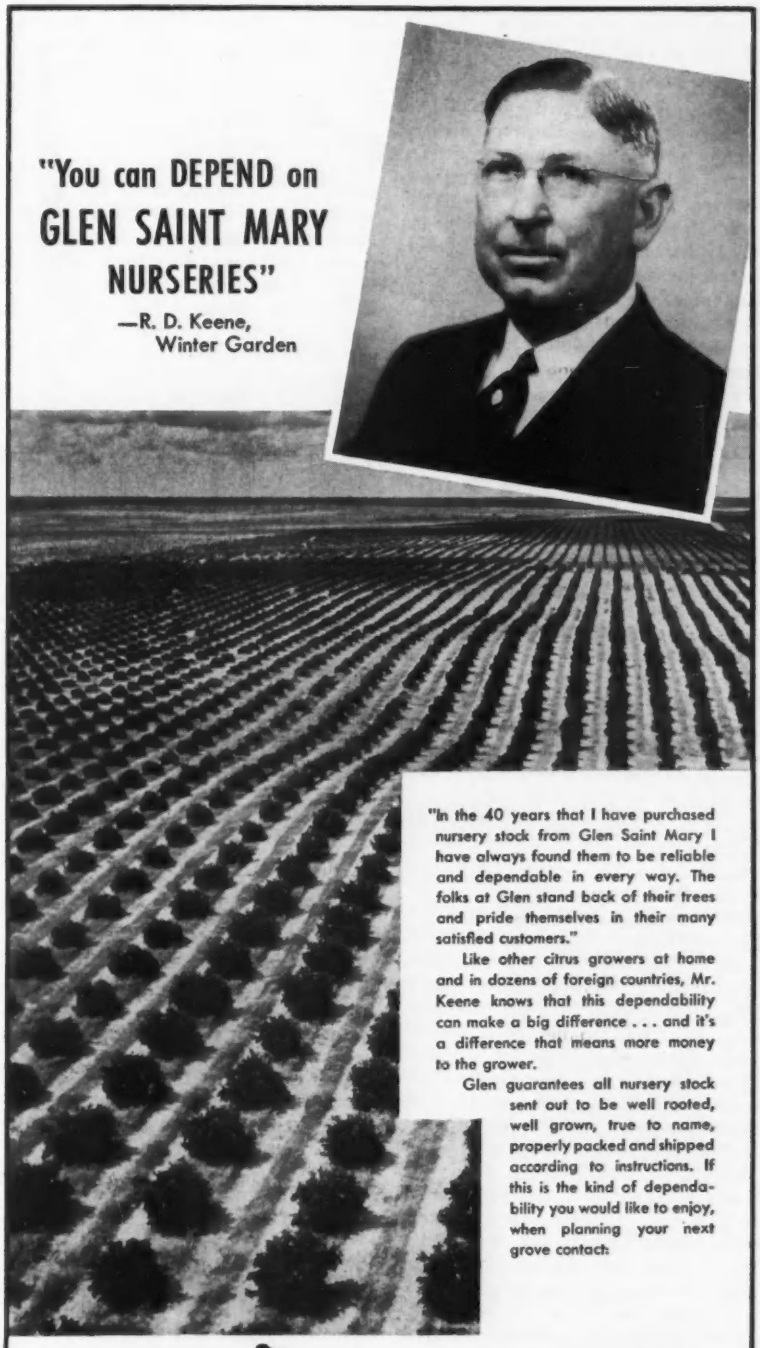
score taken for all treatments during August 1954 and August 1955. Trees sprayed with oil had poorer foliage density than did trees sprayed with parathion, and trees sprayed with either insecticide had poorer foliage density when sprayed in the summer months than when sprayed at other times of the year, probably as a result of the summer scale population.

Dead Wood.— The scale infestations of 1952 and 1953 resulted in much dead wood development in some of the trees. Dead wood was pruned from each tree every winter and weighed. Weights were relatively large in December 1952, very large in January 1954, and relatively small in January 1955. Presumably the small loss during 1954 was due partly to previous loss of wood, and partly to lower scale infestation. Total dead wood losses for January 1954 and January 1955 are given in Table 2. Loss was heavier for oil than for parathion, and heavier for June, July, August, and September spray dates than for other months of the year. Plots receiving two oil sprays lost only as much wood as plots receiving one oil spray in the dormant period, indicating that dead wood was not increased by the summer oil. These results correlate closely with the foliage density index also shown in Table 2.

Fruit characteristics.— Observations were made on the quality and size of the fruit produced on the various plots.

Fruit color was fairly good in the spring of 1953, but was rather poor on all plots in the comparable period in 1954 and 1955. Some factors in the poor color are thought to be the type of soil on which the fruit was grown, and the possibly more than adequate level of fertilization. Fruit color was studied by observation of whole trees, by grading a number of individual fruits for color on each tree before picking, and also by grading individual fruits for color in the field boxes at picking time. At this time, no influence on color can be assigned any of the treatments.

Juice quality samples were taken in March on each year. Average soluble solids for the 1954 and the 1955 samples are given in Table 3. The differences found were not large, but fruit from parathion plots averaged 0.35 degrees Brix higher in soluble solids than fruit from oil plots. The combination of post-bloom and summer oil sprays was more detrimental to soluble solids than a single oil spray, regardless of when the single spray was applied. If sprays of either oil or parathion were applied in the period June 1 through September 1,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lower soluble solids resulted than if applied at any other time.

Other juice quality factors were less consistently related to the treatments. Acidity of the juice was very slightly higher in the parathion plots and slightly lower in the midsummer sprayed plots. The ratio of soluble solids to acidity was not affected by the scalicides, but was slightly higher in the midsummer-sprayed plots. Juice content of the fruit was not affected by the treatments, nor was Vitamin C in the one year determination was made.

Fruit size was measured on the tree by the use of hand calipers on January 27, 1954 and again on March 15, 1955. The average of these two years is presented in Table 4. Larger fruit was found on the summer-sprayed plots regardless of scalicides, and on the oil-sprayed plots rather than parathion plots. These trends are the exact opposite of the yield trends to be presented below, and most of the difference in fruit size can probably be credited to the difference in yield.

Yield of fruit.— Yield of the trees was obtained by commercial picking operations, and is reported in terms of number of field boxes per tree. In April 1952, yields were recorded in order to test the uniformity of the experiment. This crop had been practically matured before the beginning of the experiment the preceeding December. No significant difference were found either in the scalicide treatments or the timing treatments. The yield in May 1953 was uniformly low, not only in the experimental plots, but also in the entire Valencia grove. Again no significant differences were found in the yield data. Considerable yield differences were found in the crops picked in June 1954 and May 1955. The average yield per tree for these two crops is presented in Table 4. All trees sprayed with oil averaged 2.6 boxes per tree, while all trees sprayed with parathion averaged 3.2 boxes per tree, or 23 percent more fruit than the oil sprayed trees. Lowest yields in parathion sprayed plots were obtained from the trees sprayed in July. Lowest yields of the oil sprayed plots were obtained also from the trees sprayed in midsummer, but fall application of oil also resulted in relatively low yields. Averaging the results for parathion and oil in these two years, all plots sprayed between January 1 and April 1 produced 3.3 boxes of fruit per tree per year, while plots sprayed June 1 or July 1 produced only 1.9 boxes. Thus the dormant or post-bloom sprays resulted in 74 percent more fruit than sprayed trees produced 14.4 pounds of soluble solids per tree per year while parathion-sprayed trees produced 18.3 pounds of soluble solids per tree per year, or 26.6 percent more than oil-sprayed trees. Most of the 26.6 percent difference was due to 23 percent difference in yield.

In view of the advantages of parathion, growers reluctant to use this material could well afford to learn to use it safely. When higher yield and soluble solids along with less pruning and more vigorous trees are considered, the economic advantage is of real importance.

Results of the timing phase of this experiment stand in sharp contrast to results of similar experiments elsewhere. Results in Central Florida indicate that the June 15 to August 1 period would give better overall control than sprays at other times, but June-July sprays. These were the July 1 parathion, the June 1 and July 1 oil treatments, and the post-bloom and summer oil treatment.

DISCUSSION

The resluts obtained from the parathion-oil comparison confirmed in all respects the previous work of Thompson et al (3). In killing scale, parathion as used was generally more effective than oil, except in winter months when it was only as good as oil. Trees sprayed with parathion had far fewer mealybugs than oil-sprayed trees. Parathion-sprayed trees were denser in foliage, had less dead wood, and yielded 23 percent more fruit than oil-sprayed trees. The fruit from parathion-sprayed trees was also higher in soluble solids.

Since some Indian River fruit goes to concentrate plants, calculation of the amount of soluble solids produced per tree might be of interest. Assuming that a box of fruit weighs 90 pounds and using the actual juice content average of 51.8 percent, oil-

Table 4. Effect of Scalicide and Time of Spraying on Average Fruit Size and Yield

Approximate time of spraying	Fruit diameter, mm, av. of Jan. 27, 1954 and Mar. 15, 1955		Yield, boxes per tree av. of 1953-54 and 1954-55 crops	
	Parathion	Oil	Parathion	Oil
Jan. 1	66	68	3.1	3.4
Feb. 1	67	68	3.9	3.5
Mar. 1	67	66	3.0	3.4
Apr. 1	66	70	4.0	2.5
May 1	68	69	2.6	2.2
June 1	70	70	2.2	1.8
July 1	70	70	1.9	1.6
Aug. 1	69	70	3.0	2.5
Sept. 1	68	70	2.9	2.4
Oct. 1	67	68	3.5	2.4
Nov. 1	67	69	4.1	2.5
Dec. 1	66	70	3.5	2.9
Postbloom and summer	67	70	3.5	2.1
Av. all times	67.5	69.1	3.2	2.6
No scalicide	67.3		2.2	
"F" Values				
Time of spraying	4.45**		6.13**	
Scalicides	54.25**		36.80**	
Time x Scalicide Interaction	2.92**		3.20**	

* — Significant at 5 percent level
** — Significant at 1 percent level

mer scalicide in 1955 and came through the summer in good condition.

The data and discussion above leads to belief that a real difference exists between Indian River area and Central Florida in regard to timing scalicide applications. At present there is no proven reason for this difference. An obvious possibility is the difference in temperature. The Ft. Pierce area averages about 3 degrees F. warmer in January than the Lake Alfred area, and is liable to frost less than one-half of the years while Polk County is liable to frost every tures would be favorable to scale year (1). The higher winter temperadevelopment and might possbily allow earlier buildup of scale populations in the Ft. Pierce location, thus requiring earlier applications of scalicides to prevent damage. Inadequate

in this experiment that period was comparatively unsatisfactory. However, this does not actually constitute a discrepancy in results. The June-July recommendation was extended to the Indian River area in the absence of data indicating a superior program could be devised. Prior to the experiment described above, the effectiveness of dormant scalicides had not been tested in the Indian River area. Therefore, the data presented here should be regarded as a supplement to data previously reported, rather than as contradictory evidence.

There is a limited amount of experience in applying the results of this experiment to commercial groves. The senior author has had two commercial blocks in the Indian River area on a program of only dormant or post-bloom scalicides for two years, and these blocks remain in satisfactory condition. Also, the non-experimental areas of the Indian River Field Laboratory grove received a post-bloom parathion spray, but no sum-

scale population records on the Ft. Pierce experiment make proof of this hypothesis impossible. but the records shown in Fig. 1 do indicate a high scale population present on June 1 of all years of the experiment. The sprays applied in the dormant season or post-bloom apparently were effective in preventing development of the high summer populations, while the June 1 and later sprays were applied

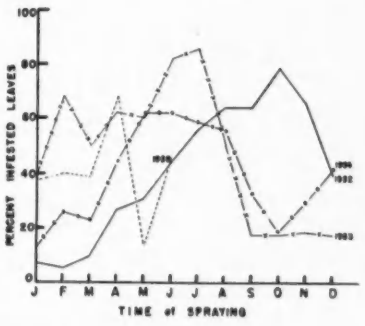

Fig. 1. Purple Scale infestations on trees scheduleed to be sprayed, as determined immediately prior to spraying.

to trees with existing high populations. It is very difficult to get satisfactory control of a high scale population with a single spray application. Possibly the hypothesis of an earlier scale population buildup is inadequate to accept for the results obtained, but the results seem to have practical value regardless of their explanation.

Some East Coast growers may wish to try the indicated timing program. This essentially means placing greater reliance on scalicide applications in the dormant and post-bloom periods, and less reliance on the customary summer spray. Such a program would consist of an application each year in the dormant or post-bloom periods, followed by additional sprays in other periods of the year as necessary in some years to keep the population in check. This simply means substitution of the dormant or post-bloom period for the summer spray period as the basic practice. In many cases the application of a second scalicide will be advisable in a single year. Respraying should be necessary less frequently where the scalicide is put on dormant or post-bloom rather than in midsummer.

The usual precautions should be observed in applying oil emulsions in dormant and post-bloom periods. Oil sometimes damages trees severely if applied during drought, and may render trees susceptible to cold damage if the application is made in the winter prior to freezing weather. Oil may also cause undesirable marketing of fruit if applied post-bloom when

(Continued on page 22)

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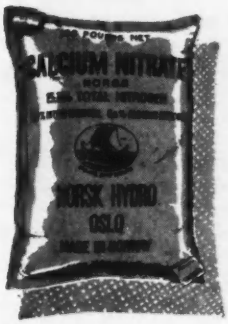

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Activities Of The Experiment Station In Production Research

Over the past years, research men from the Citrus Experiment Station have appeared before the Indian River Citrus Seminar to present the results of their research. Some of the work they have reported resulted from experiments conducted on the East Coast and much of this information has been put to practical use in this area.

As you know, the Citrus Experiment Station of the University of Florida is supported largely by tax money appropriated by the legislature, and the Station has the responsibility of conducting research for the citrus industry of the state. Research equipment and methods have improved greatly, particularly in the past decade, with the result that the research workers now can delve more thoroughly and more deeply into some of the problems that have been baffling the industry for years. Spectrographic and photometric methods of analysis have provided us with clues to some of the troubles and have greatly industry for years. Spectographic and photometric methods of analysis have provided us with clues to some of the troubles and have already speeded up the tedicus analysis of samples from experimental plots. Such an instrument as the automatic Geiger counter allows us to use radioactive elements to trace the movement of nutrients in plants, a technique that helps us get at the mechanism of plant feeding.

The tendency in recent years has been for research workers to be centralized in large laboratories where these complicated and expensive instruments can serve a large number of workers; and where library facilities and other aids to research are readily available. In keeping with the needs of the expanding citrus industry, the central research unit at Lake Alfred also has expanded. However, the necessity for conducting field experiments of a commercial nature has not diminished; in fact, it has increased due to the need for confirming laboratory findings and adapting them to local conditions and situations. The facilities of the Indian River Field Laboratory at Ft. Pierce are extremely useful in studying the problems peculiar to the East Coast. Likewise, the excellent cooperation received from growers in this area has done much to further the local field trials.

W. A. SIMANTON
CITRUS EXPERIMENT STATION,
LAKE ALFRED

I wish to take this opportunity to tell you something of the facilities of the Citrus Experiment Station and to bring to your attention some of the research activities now in progress. Also I wish to mention certain lines of work that we think should be carried on in a long-term program to help us control or even eliminate some of the problems that now plague us.

The Citrus Experiment Station has come a long way since it was authorized by the legislature in 1917 and started in 1919 with $10,000 of funds donated by citrus growers. By 1923 the 84 acres of land at Lake Alfred had been largely planted and a house and a two-room laboratory had been built. By 1927 a little larger laboratory and a greenhouse had been constructed. Funds for operation of even these limited facilities were very meager until 1935, when an appropriation of $46,000 was received. Forty acres of land donated by the Florida Agricultural Research Institute was added to the holdings and the original small laboratory was enlarged. Research in the period 1935 to 1945 was concerned largely with finding a proper nutritional program for the generally unthrifty citrus groves prevailing at that time. As a result of that work, production and condition of trees was greatly improved. After the war situation eased in 1945, most of the present buildings were constructed and the activities of the Station were expanded to include, in addition to production research, work on the harvesting and handling of the crop, and on processing and by-products utilization. A staff to handle these increased activities was recruited until at the present time it numbers 54 research scientists. These are aided by about 60 mechanics, helpers, laboratory assistants, and laborers. The original Station groves have been used over and over again for so many experiments that some plantings are now unsuitable for reliable experimentation. For this reason new land was needed, particularly for long-term fertilizer experiments, and in 1955 the Station acquired 215 acres of new land which will be planted and used in future years.

The Lake Alfred research men had been making frequent trips to the East Coast to conduct experiments and to advise on growers' problems. When the 30-acre St. Lucie County grove was turned over to the Citrus Experiment Station for research purposes in 1947, these facilities for East Coast research were put to very good use. The area has been improved, buildings renovated, a new building constructed, and new groves planted on some of the vacant land. In 1951 this property and adjacent land now being used for research with vegetables and other crops was organized into the Indian River Field Laboratory as part of the Experiment Station system.

Insect and mite control has always been an important part of our research program, since controlling these pests accounts for a large part of the grower's expense dollar. Even with the hundreds of promising chemicals that have been offered by the large industrial research laboratories, we still have not come very close to finding the ideal material — one

1 Presented before the Indian River Citrus Seminar, Vero Beach, November 17, 1955.

that can be relied on always to do an excellent control job. Entomologists have been looking for many, many years for such materials and it is likely that they will always be looking. We now have better pesticides and a wider variety to choose from, but we still have to work out the limitations for all of these materials and devise recommendations for their proper use. New experimental pesticides submitted by chemical firms as a result of their own extensive screening have to be tested by us for compatibility with the other materials used in spray mixtures for citrus. Safe handling practices need to be devised and then field experiments conducted and closely observed for two or three years. For example, when parathion was found to be an effective scalicide for citrus, proper methods of use were studied in great detail by the Station before it was recommended. As a result, parathion is used with greater safety and efficiency in Florida than in any other state. Even then, after the material is recommended to growers, troubles are bound to occur in widespread commercial use and these have to be ironed out. Three of our entomological workers spend a great deal of their time in the testing of new materials that offer promise as citrus pesticides in Florida.

With the older pesticides much can be gained from timing experiments. Timing of applications has been fairly well worked out for the Ridge areas of Florida, but even then more experiments and coorelations are needed to take into account weather and ecological conditions. Your conditions here on the East Coast differ from those in the Ridge area. We know that in this area timing of scalicide sprays should differ from that in the Ridge area. One of the papers on this program points to better scale control obtained in timing experiments at the Indian River Field Laboratory. Similar experiments need to be undertaken to study timing of miticides as well, and these are in view.

Seven of our staff are engaged in entomological research, two of whom are permanently stationed in this area. Dr. John King has been at Ft. Pierce only a few months, but having worked with citrus for a number of years he was able to pursue his research program without delay. He is undertaking the timing experiments previously mentioned and is also working on the Fullers rose beetle which is destructive to citrus in this area. He cooperates very closely with Mr. Thompson, who has been at the Lake Alfred station almost since its beginning, and also with Dr. Johnson at Lake Alfred who is working on the chemical control of pests, particularly mites. Dr. McBride, a chemist, works on the compatibility of spray materials and also evaluates residues of these materials. This kind of work has become very important during the past two years and will continue to be in the forefront for another year in view of the Federal law, referred to as the Miller bill, which concerns residue tolerance on all foodstuffs and in a general way controls the sale and use of all pesticides.

It would be a great advantage to this citrus industry if we could make better use of natural control. Under some conditions parasites and predators do a good job but their effectiveness is complicated by many factors. You are familiar with the scales and mites that are common pests on citrus. You also know that many other kinds of insects and mites occur on citrus groves. Three years ago, Dr. Muma was given the job of finding out what these species are and what they are doing in the grove. All of this is background for the studies to deter-

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mine ways of assisting natural control. He has identified most of the species found in groves and has studied many of them in detail. In the course of this work two new pests, the Texas citrus mite and the broad mite, have been recognized as causing damage to citrus in Florida. On the encouraging side, numerous parasites and predators of nearly all of the citrus pests have been found. Included in these are 11 predators of armored scales and as many as six parasites of the Florida red scale. This work is conducted in several groves throughout the state, one of which is located near Ft. Pierce. In that grove the effects of cultivation practices such as discing and mowing, as well as the use of sprays, are studied with respect to the natural control obtained. The practice of maintaining tree snails in groves is also being evaluated.

In a past meeting you have been addressed by Dr. Pratt who heads the survey project in which 130 groves over the state are examined for 28 injurious insects and mites, 13 parasitse and predators, 23 diseases and symptoms, and 10 cultural practices and conditions. One of his men, Mr. Holtsberg who lives in Cocoa, surveys 27 groves up and down the East Coast each month. The results of these surveys are analyzed and tabulated and the results made known in the form of weekly bulletins to county agents and production managers, together with any timely control recommendations.

On the disease side of the picture, we have kept abreast of such diseases as tristeza and leprosis so that we are no longer greatly concerned about them. We are also making considerable progress in other diseases, particularly the nematode-induced spreading decline which fortunately is not a grove problem on the East Coast. Melanose and scab are still with us, and although they are can be controlled by proper spraying with copper, such copper sprays cause complications in promoting the buildup of mites and scales. New fungicides are being tested continuously against these diseases but up to the present time nothing has been found to be as effective or as economical as copper. Two other diseases against which copper has some effectiveness are greasy spot and brown rot. Greasy spot has been a serious problem in the Ridge area for several years, and in certain groves on the islands of the East Coast area it has been severe. Greasy spot has been studied mainly by the entomolgists since it was thought to be tied in with mite infestations; however, the latest information is that it is of fungus origin although the details of the infection are not thoroughly worked out. With some of the troubles such as psorosis, tristeza, gummosis, exloporosis and exocortis the grower can hope for some relief through the Budwood Certification Program which has been going about three years. This is handled by the State Plant Board in cooperation with the Citrus Experiment Station. Numerous trips are made by our staff to East Coast areas to inspect candidate trees for certification as budwood sources.

It has become increasingly evident in all citrus growing areas of the world that many of the commercial varieties of citrus harbor viruses which, under certain conditions and with appropriate stock-scion combinations or efficient vectors, can work great havoc in citrus growing areas. With tristeza, for example, the budwood certification will help us only if efficient insect vectors can be kept out of the state. Viruses are elusive things that in the main can be studied only by indirect methods. You cannot eliminate a virus in a symptomless carrier unless you have some means to detect it. This may be a chemical test, a physical response, or some horticultural means such as transmission to a susceptible plant. This is a field in which much fundamental study is necessary. It is also expensive research and not likely to yield much in the way of results for several years. Fortunately, two years ago we were able to get started on a study of these viruses and two virologists are now engaged in that work. The ultimate goal is to lean up the varieties of virus diseases through the Budwood Certification Program and also through the development of nucellar varieties. Clean-up of these varieties is a thing that has long been needed, not only from the disease standpoint but from the horticultural viewpoint as well. California has been working on the cleaning up of their strains and on the development of nucellar varieties for a number of years. Recently the Florida industry has recognized the importance of this work and as a result we hope to undertake more work along those lines at the Lake Alfred station.

Seven pathologists handle the disease research, of whom four devote most of their time to the spreading decline investigation which is so important to many citrus areas of the state at the present time. Although he containment program is now under way by the State Plant Board to control spreading decline, it is going to take a lot more research if the industry is to learn haw to live with these pests as a long-term proposition. Another pathologist is being added to the staff to further expand the breeding of citrus for resistance to nematodes and diseases. Trials with new root stocks in relation to their suitability for East Coast conditions are now under way in three East Coast counties. It is our intention to place a full-time pathologist at the Indian River laboratory to handle the disease work in this area. In general, the groves on the East Coast look much better than they did a few years ago, but they are subject to several decline conditions that shorten tree life and these need to be studied further.

Six of the staff devote their time to the nutrition of citrus trees. Feeding the trees is an absolute necessity in Florida and the cost of fertilizers is a substantial part of the grower's expense. Long-term experiments are necessary for nutrition research and reliable results cannot be expected until several seasons have passed. At Lake Alfred experimental plots have been running for many years to study the effect of nitrogen sources, potash, phosphorus and magnesium as well as pH control. We recognize that the different soil, moisture and cultivation conditions in the coast area require separate studies. Extensive long-term experiments are being conducted by Dr. Reitz in the Indian River Field Laboratory groves. Much of the basic nutritional work, such as the evaluation of source materials for fertilizers, the nature of fixation of elements in soils, and the study

(Continued on page 24)

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Sub-Soil Drainage As A Factor In The Spread Of The Burrowing Nematode

E. P. DuCHARME
FLORIDA CITRUS EXPERIMENT STATION, LAKE ALFRED

A characteristic of spreading decline of citrus caused by the burrowing nematode, **Radopholus similis** (Cobb) Thorne, is the spread of this disease in all directions from a center of infestation. The average annual spread of the margin of infested areas has been calculated to be approximately 1.6 trees per year, Suit (2). The rate of spread of infested areas varied from grove to grove and from year to year in the same grove. As the reason for these differences in the rate of spread was not known, work was started to study this problem. Of the possible factors considered, the movement of water in the soil seemed to be pertinent to the problem. It is the purpose of this paper to present observations on water movement through the soil as a factor in the spread of burrowing nematodes.

Observations on the expansion of spreading decline areas were made by plotting detailed maps of affected groves to indicate the area of declining trees. These groves were remapped annually to record the changes in the size and shape of the disease areas. A comparison of the maps showed that spreading decline expanded in all directions but that the spread was not always equal in all directions. In groves on level land the expansion of diseased areas was more or less uniform on all sides. In groves on hillsides the affected area spread uphill as well as down, but in some the spread was more rapid downhill.

After spreading decline was found to be caused by burrowing nematodes (1), this study was repeated in a grove having a small infested area on a hillside. The area was mapped on the basis of visibly declining trees and the margin of the area infested with burrowing nematodes was determined by sampling roots of apparently healthy trees beyond the visibly affected trees. One year later the area was re-mapped on the basis of visible symptoms and the new margin of the area infested by burrowing nematodes was determined.

The study showed that burrowing nematodes infested an area larger than that of the trees having visible symptoms of decline and that the burrowing nematode margin was farther in advance of the visibly affected area downhill than uphill. One year later, burrowing nematodes had spread uphill less than 25 feet, whereas on the downhill side the margin of the infested area had moved 200 feet. This evidence suggested the possibility that the movement of water in the soil caused the differential rate of spread. To find out whether or not the percolation of water in soil would influence the movement of burrowing nematodes, an infested citrus seedling growing in a 5-quart metal pot was taken in the laboratory and flooded with water. The drainage water from the potted plant was examined for burrowing nematodes. This procedure was repeated for three days. Each time active burrowing nematodes were recovered from the drainage water.

A second experiment devised to study the influence of water on the movement of burrowing nematodes through the soil consisted of passing nematodes through a column of sand 3 inches in diameter and 42 inches long. Yellow Lakeland type subsoil was thoroughly washed to remove all nematodes, cleaned of roots and organic matter, and then placed in a glass cylinder where it was allowed to settle for two days. Active burrowing nematodes and other free living nematodes were placed in the top inch of the soil column and water was added intermittently from above. After the water percolated through the soil column it was collected and passed through a 325 mesh sieve.

Thirty hours after infesting the top of the soil column, the first burrowing nematodes, .6mm. long and .2mm. in diameter, were recovered from the drainage water. Dorylaimed and Rhabditid nematodes 1.5 to 2mm. long came through in less than 30 hours. The only nematodes to pass through the column of soil were active; dead ones were never recovered. The movement of water through the soil apparently facilitated the passage of the nematodes but didn't carry them along in channels. Five weeks after the start of this experiment, burrowing nematodes could still be leached from the soil column. It was found in a second experiment that burrowing nematodes survived for 8 weeks in the soil column without food and could then be recovered by percolation of water.

The rapid passage of burrowing nematodes through the soil column and their ability to survive for at least 8 weeks without food suggested the possibility that burrowing nematodes might be present in the water table below infested citrus groves. For the purpose, shallow wells 8 to 9 feet deep reaching to the water table were made at the edge of two centers of spreading decline. Short sections of 6-inch diameter irrigation pipe were pushed into the soil and the soil inside the casing carefully removed so that no surface soil fell into the well. About 15 gallons of water was pumped from the water table in each well and passed through a 325 mesh sieve. Mononchid-like predaceous nematodes and a few other kinds of nematodes were present in the water from both wells. One female burrowing nematode was found in the water from one well.

Conclusions

Burrowing nematodes move about easily in the Lakeland type sand soils characteristic of citrus groves in central Florida. In this soil the air spaces are large and the downward movement of water is rapid. Moist soil is necessary for nematode migration and the percolation of soil water influences the direction and rate of burrowing nematode movement so that they are able to travel relatively long distances

downward in a short time. Burrowing nematodes must be individually active to be influenced by the movement of soil water. Inert and dead burrowing nematodes are not carried along in the flow of soil water. Moist soil is necessary for nematode migration; consequently burrowing nematodes move more readily in citrus groves during and immediately following the rainy season. Experience has established that the best time for taking burrowing nematode samples is from July to early January, when soil moisture is likely to be plentiful.

Burrowing nematodes present in the water table may not be an important factor in the spread of burrowing nematodes. Citrus roots do not survive in water; therefore a burrowing nematode in the water table would not find growing roots. Also, the survival of burrowing nematodes in the water table would be unlikely because of the predaceous nematodes present. Thus burrowing nematodes in the water table most probably will either starve to death or be eaten.

Burrowing nematodes are able to survive in water and moist soil for two to three months without food. This would permit them sufficient time to move long distances with the aid of water. To date, the investigations have not progressed sufficiently to establish whether or not burrowing nematodes might be carried over a hardpan or clay layer by the lateral flow of subsoil water.

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2. Suit, R. F. and H. W. Ford. 1950. Present status of spreading decline. Proc. Florida State Horticultural Society 63: 36-42.

CITRUS INSECT CONTROL FOR FEBRUARY 1956 . . .

(Continued from page 3)

ovotran at 1 pound per 100 gallons. For rust mites, ½ gallon of lime-sulfur combined with 5 to 10 pounds of wettable sulfur is fairly safe on succulent foliage and may be used with ovotran, but should not be used with aramite or EPN-300. If aramite or EPN-300 are used, merely omit the lime-sulfur.

Aphid Control: Where aphids are a problem, control measures should be applied before leaves are curled and before the populations reach high levels. Parathion, TEPP, or nicotine sulfate will all give good control of aphids if applications are applied early and thoroughly. Use TEPP and parathion according to the manufacturer's precautions and directions and nicotine sulfate at 1 pint per 100 gallons.

Nutritional and Fungicidal Sprays: Except where new foliage has not appeared or where sprays must be applied for other purposes, it would be preferable to delay application of copper and zinc compounds until post-bloom. However, in groves where scab is a problem and a dormant copper was not applied, it would be preferable to apply a copper spray than to take a chance on a severe scab infestation. Also, where dead wood has followed a severe leaf drop, a copper spray will protect new foliage from melanose.

For more detailed information refer to the 1956 "Better Fruit Program," or consult the Citrus Experiment Station at Lake Alfred or Fort Pierce.

CUTTINGS SALE SOON

County Agent F. E. Baetzman of Orange County says Lake Emerald grapes will be available "sometime in January or February" to Central Florida residents. Baetzman and the Florida Grape Committee are completing such details as packaging, etc., for the proposed sale.

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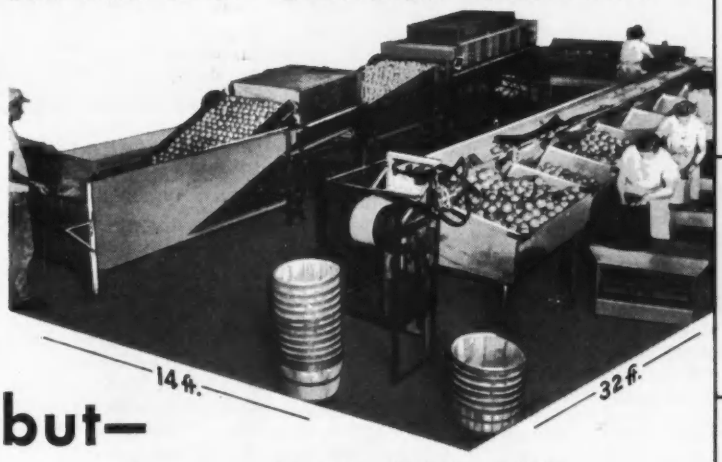

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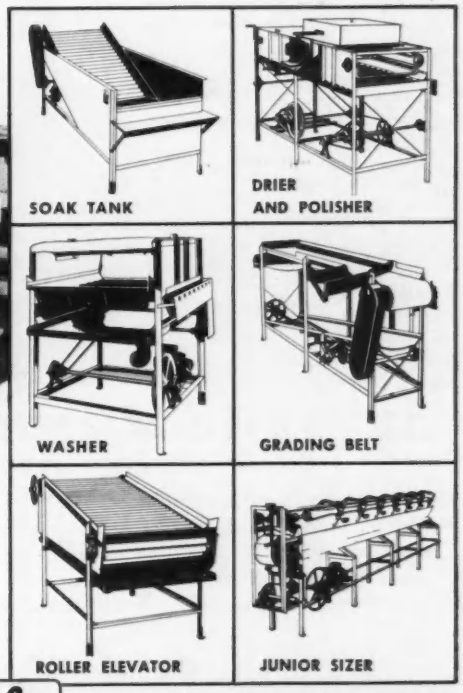

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TIMING OIL & PARATHION SPRAYS FOR PURPLE SCALE CONTROL IN SOUTHERN INDIAN RIVER AREA.

(Continued from page 15)

the young fruit is between 0.5 and 1.5 inches in diameter. There are no restrictions from these standpoints with parathion, but the spraying should be done on warm days with as little wind as practicable.

As a final note of caution, growers who try this program should do so with the reservation due all relatively new practices. Growers should be particularly observant in regard to red scale for in the experiment, red scale were not a problem, and the suggested program may be ineffective against them. The program suggested here has a firm basis in experimental work, and has been satisfactory in a limited number of commercial applications, but cannot be recommended without reservation until further experience has been obtained, particularly in commercial groves.

SUMMARY

A spraying experiment conducted at the Indian River Field Laboratory grove near Ft. Pierce, Florida has yielded data further confirming the relative merits of parathion compared with oil emulsion for the control of purple scale. Compared with oil-sprayed trees, parathion sprayed trees had lower purple scale populations and far fewer mealyubgs, were more dense in foliage and had less dead wood, and bore 23 percent more fruit containing 0.35 degrees Brix higher soluble solids in the juice.

Studies of the most beneficial time of application of a scalicide indicated that sprays applied in the dormant or post-bloom periods were of greater value than sprays applied in the summer months. Compared with sprays applied in June and July, sprays applied between December 1 and April 1 allowed denser foliage, less dead wood and higher yield of fruit.

Practical suggestions as a result of this study include use of parathion rather than oil emulsion for control of purple scale, and shifting the regular scalicide application from the summer period to the dormant or post-bloom period.

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2. Thompson, W. L. 1942. Some problems of control of scale insects on citrus. Proc. Fla. State Hort. Soc. 55:51-59.

3. Thompson, W. L., J. T. Griffiths, and J. W. Sites. 1951. A comparison of oil emulsion and parathion for the control of scale insects on citrus. Proc. Fla. State Hort. Soc. 64:66-71.

FLORIDA CITRUS EXPOSITION THE WORLD'S GREATEST WINTER HAVEN — FEBRUARY 13-18 Inclusive

(Continued from page 8)

11:00 A. M. "Wish Upon A Star" N. B. C. Network Broadcast — Nora Mayo Hall

2:00 P. M. Florida Citrus Mutual Program — Announcement of awards in Fresh Fruit Contest — Nora Mayo Hall

2:30 P. M. Hippodrome Acts, Lake Silver Amphitheater

7:30 P. M. Hippodrome Acts, Lake Silver Amphitheater

10:30 P. M. Fireworks display in front of Amphitheater

FRIDAY

Governor's Day — Press Day

10:00 A. M. Gates Open

11:00 A. M. "Wish Upon A Star" N. B. C. Network Broadcast — Nora Mayo Hall

1:00 P. M. Governor's Luncheon*

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7:30 P. M. Hippodrome Acts, Lake Silver Amphitheater

9:00 P. M. Press Breakfast — Nora Mayo Hall*

10:30 P. M. Fireworks display in front of Amphitheater

SATURDAY

All Florida Day

10:00 A. M. Gates Open

2:30 P. M. Hippodrome Acts, Lake Silver Amphitheater

7:30 P. M. Hippodrome Acts, Lake Silver Amphitheater

10:30 P. M. Fireworks display in front of Amphitheater

All events listed in this program which are followed by (*) are invitational.

EFFECTIVENESS OF THE PULL AND TREAT METHOD FOR CONTROLLING THE BURROWING NEMATODE ON CITRUS

(Continued from page 10)

that the pull and treat method will control spreading decline in a grove.

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1. Suit, R. F. and H. W. Ford. 1950. Present status of spreading decline. Proc. Fla. State Hort. Soc. 63: 36-42.

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4. Suit, R. F. 1954. The experimental basis and limitation of the pull and treat method of handling spreading decline. Proc. Fla. State Hort. Soc. 67: 85-89.

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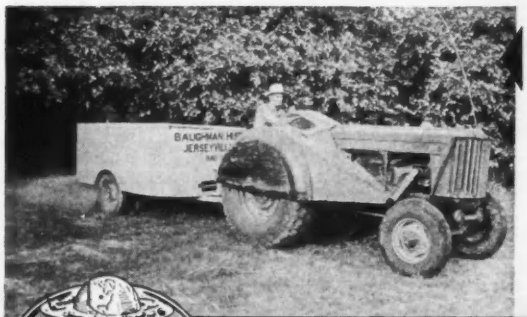

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ACTIVITIES OF THE CITRUS EXPERIMENT STATION IN PRODUCTION RESEARCH

(Continued from page 18)

of the uptake of nutrients into the trees through the use of radioactive tracers, is carried on at Lake Alfred where facilities are available for green-house studies and sufficient analytical equipment is on hand.

There is no end to this nutrition research, however. As the general age of the trees in Florida advances, and as the soils become altered by grove practices — in some cases by too much fertilizer — new problems arise. It is our custom to always determine the results of an experiment, whether it be for a study of fertilizers or sprays or some cultivation practice, on the basis of an actual packinghouse type of yield record; that is, how many boxes of packed marketable fruit of a certain grade are produced. We also evaluate the internal quality as well as external quality of that fruit. In areas where drainage is an inherent problem, grove maintenance in addition to yield is particularly important, and with the limited rooting zone available we need to obtan full utilization of the nutrients applied.

In the field of secondary nutritional elements we feel that the Station has been particularly successful. Iron deficiency has generally been quite prevalent over the entire state, but in the past two years much of it has been corrected by use of the iron chelate developed at the Station. The EDTA form, while very effective on the acid soils common in the central area, is of very little value in alkaline soils such as occur on the East Coast. EDTA-OH, another form of iron, is a better corrective in some cases but it is expensive and is not always effective. Where it is effective, it lasts a long time and improves tree condition and fruit quality. A survey has shown that citrus leaves in the East Coast areas show somewhat less iron than do leaves over the state on the average. Just recently our research has turned up a compound that is very effective in correcting iron deficiency on a wide variety of soils, including the alkaline soils, so we now know that there is a material that is as effective as EDTA is on the acid soils. This particular material is not now avalable commercially but developments are under way to see if it can be made available in quantity at reasonable cost. These experiments with iron are being conducted in three groves on the East Coast.

Methods of supplying zinc are also being studied, not only from the standpoint of getting adequate amounts in the tree but also to try to get the zinc in through the soil rather than by sprays and thus reduce the spray residues that promote scale and mite buildup: Most of this work is being conducted at Lake Alfred where a series of pot experiments is under way, some of which contain the East Coast soils. In the pots, radioactive forms of zinc are used as tracers to study the uptake of the zinc. Zince analysis of leaves and soils is very difficult at the low concentrations we are working with, and this work is best done at Lake Alfred where the equipment s available for the analysis and tracer studies.

The cause of the leaf condition known as yellow spot was identified three years ago as molybdenum deficiency by the Station. Primarily yellow spot has been a problem of citrus grown on acid soils and previously has not been severe on the East Coast. With new plantings of citrus extending back from the Coast into more acid soils, symptoms of molybdenum deficiency are more common, particularly on young trees. A spray containing as little as one ounce of molybdenum salt per 100 gallons gives spectacular correction.

In some areas there is the problem of getting adequate amounts of magnesium and potassium into the tree, particularly where soils are already high in calcium and sodium ions as is frequently the case in East Coast groves.

Since most nutrients find their way into the tree through the roots, a

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study of the root system is a very vital part of citriculture and considerable progress is being made along this line. I can say that more knowledge of roots has been acquired within the past three years than within the previous 30 years. Dr. Ford has been the man primarily responsible for this research and he is on your program today to pass on to you some of the things he has found out about root systems in relation to drainage. One aspect of a fundamental nature that we are now investigating is what happens to the soil and roots at the deeper levels. We can do something about correcting pH, for example, in the upper few inches of the soil but only a small proportion of the roots are located in that zone. Through application of various types and kinds of fertilizer and subsequent soil analysis we are getting some knowledge of the soil reactions and quantity of nutrients available at the lower depths. We are also studying the efficiency of the root systems at these different depths through the use of radioactive elements as tracers. Field studies of roots in areas where drainage can be controlled by efficient tiling and ditching systems are being conducted at Cocoa and also on the West Coast of Florida.

Irrigation studies tie in closely with the root work as well as with the nutrition and fruit quality research. Irrigation practices can stand much improvement in the Indian River area. In many cases money spent for irrigation would be far better spent in stabilizing the water table to increase the root zone and letting the deeper roots supply the water for the tree.

Studies of fruit quality have always been a considerable part of our research. While it is true that fruit quality can be influenced to a certain extent by such nutrients as nitrogen, potassium and iron, our efforts along these lines are rather meager when compared to the greater differences in fruit quality that are associated with rootstocks, soil types, and especially the climatic conditions from season to season. This is particularly true when you consider the factors that influence the early maturity of grapefruit about which Dr. Deszyck spoke to you yesterday. Here we are up against a number of man-made problems. For example, grapefruit which normally matures in the winter months has already had its marketing season doubled by arsenation and other practices developed by horticulturists. You can realize that changing the habits of grapefruit to meet man-made specifications is a hard thing to do. A certain amount of this manipulation is no doubt an advantage in marketing the crop. Nevertheless, in areas where tree vigor is low, heavy arsenation to produce early fruit is a thing to be avoided.

At the present time there is under way at Lake Alfred a fundamental study supported by a three-year grant-in-aid from one of the large fertilizer companies. This study is to determine the influence of fertilizer applications on the mineral contents of the fruit and of the leaves that are associated with that particular fruit.

Aside from research in the growing of citrus, the Station conducts other investigations that are of interest to a grower since they definitely influence the net returns from his crop. Six of our staff are engaged in studies on the harvesting and handling of fresh fruit. From this research has come the method of bulk handling new being successfully used by several packing houses. This will undoubtedly be taken up by many houses in view of substantial

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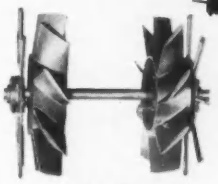

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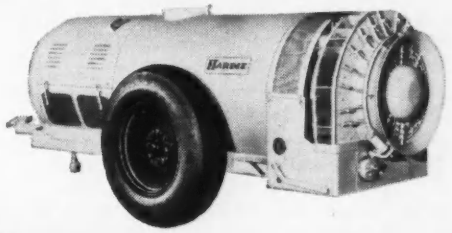

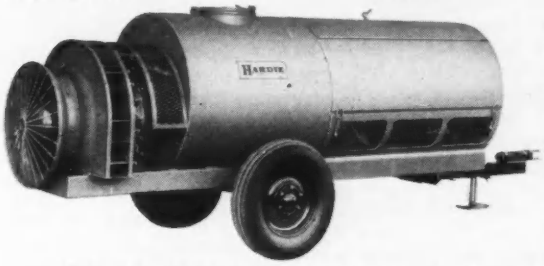

Above—Model DF-26A, 2, 26" fans, Ford V-8 Industrial Engine, 140 HP at 2600 RPM. Model DF-26-B, 2, 26 in. fans, Ford Industrial Engine, 108 HP at 2600 RPM.

At Left — Model DF-24B, low priced, 2, 24 in fans, Willys Hurricane Engine, 70 HP at 4000 RPM.

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Hudson, Michigan

savings in handling costs that have been demonstrated.

An effective decay control treatment has been developed jointly with the Florida Citrus Commission and is in commercial use. A fungicidal water wax is another development that holds promise. The designing and proper use of treated fibreboard boxes for citrus is another Station development. Any savings in handling fruit reflect almost directly in profit since at that stage the hazards on insects and hurricanes are past. Here is a field of research that has lagged in the past but which is now pushing ahead.

Processing is likewise important for without this great outlet for fruit the fresh fruit market frequently would be demoralized. Ten of our staff are engaged in this research. They are solving the problems of storage life, off-flavors and enzyme deterioration in frozen concentrates. Florida Citrus Commission funds as well as direct grants from industry aid these Station projects.

Other research has been with by-products made from peels and cull fruit. Conceivably, if a by-products industry were highly developed, the returns from the 50 percent of the whole fruit that is considered a waste product would equal the value of the edible portion. Five chemists are engaged in exploring this field and in up-gradng present by-products.

In this resume of Citrus Experiment Station activities, I have necessarily had to merely touch upon some of the fields. Before closing, I would like to comment on a few phases of our thinking. One of these has to do with fundamental research — new approaches to problems and new basic information that can be put in the bank, so to speak, for use in solving the new problems that arise. Fortunately, we have been able to start some fundamental research in the fields of virology and plant nutrition, and soon we hope, along the lines of breeding citrus for disease resistance and variety improvement.

Don't Miss
THE CITRUS EXPOSITION
Winter Haven
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The need for such basic background knowledge was strikingly evident when the spreading decline disease hit the industry. Nematodes are just one of the problems we have to expect as our agriculture becomes older. Soils become depleted, contaminated and otherwise altered with each passing year, and new land is getting scarce. Industrial development of the state may bring additional problems of air contamination and changes in the underground water sources. Thus we expect to have no shortage of citrus research problems in the forseeable future.

The other point I wish to mention is that research scientists to handle these problems are in short supply. As the President of the University of Florida stated only two weeks ago, less than half as many scientists are being trained as will be needed in the next ten years. This situation is being felt right now in our efforts to keep our present staff positions filled with qualified men. In addition to selling the new men on the advantages of living in Florida, we may have to adopt a higher scale to attract competent scientists. In the meantime, we are adopting new tools and techniques to keep the research moving at maximum rate. Allow me to assure you that all of us at the Citrus Experiment Station enjoy the challenging problems and the wholehearted cooperation we receive in serving the citrus industry.

ORANGE COUNTY GROUP BACKS COMPULSORY DESTRUCTION OF INFESTED CITRUS GROVES

LAKE ALFRED, Jan. 19—A group of Orange County citrus growers said they would approve a program by the state plant board which would force citrus growers to destroy groves infested with spreading decline.

The growers made their comments during a field trip to the citrus experiment station.

The plant board now operates a voluntary program of destruction for which the state bears the cost.

Members of the Orange County group — some 70 growers — questioned the advisability of pushing out infested groves if nearby infected groves are allowed to remain.

The Orange County group on its tour saw the plant board's fumigating machine in action on a grove being cleared. They also saw a hot water treatment for young citrus trees.

The trees are dipped into hot water for 10 minutes, which apparently kills any nematodes which might be in the roots of the tree.

The Winter Haven HERALD

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Many citrus growers over the state keep abreast of industry happenings in the Citrus Capital of Florida by reading the

Winter Haven HERALD

Winter Haven Florida

Irrigation Studies With Marsh Grapefruit On Lakeland Fine Sand In Central Florida

LOUIS W. ZIEGLER
ASSOCIATE PROFESSOR OF HORTICULTURE
UNIVERSITY OF FLORIDA

AT MEETING FLORIDA STATE HORTICULTURAL SOCIETY

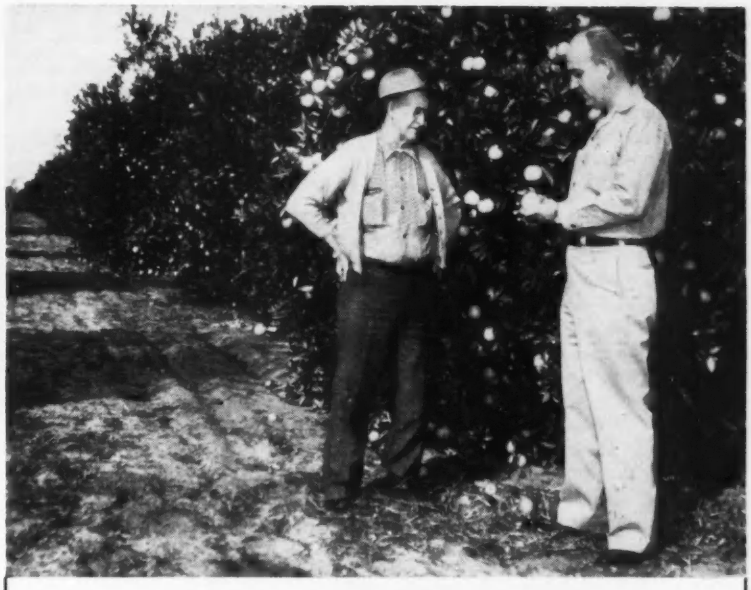
It is natural to assume that the need for supplemental water by the citrus tree will be determined by the climate conditions of the location. Nevertheless, the history of irrigation practices in Florida (a region of high humidity and rainfall) too often alludes to their necessity based upon the results of work under entirely different sets of conditions.

Rainfall in Florida portrays an irregular pattern. Weather records show an average rainy season from May through September, with lighter amounts of precipitation during the balance of the year. Periodically prolonged droughts have been suffered, often stretching from early fall into the spring months. The soils of Florida used for citrus are sandy in nature; their water-holding ability is low relative to that of the clay soils. Depth of soil for rooting by the tree affects the water reserve of the soil to a greater degree than one might think.

In 1951, Savage (1) reported that approximately 67 percent of the acreage of groves in his studies was equipped for irrigation operations. This high percentage can be attributed to fear due to the recurring droughts and to profits in some years which warranted additional investments in every way which might improve holdings. Savage (2) further reported increases of yields from irrigation practices. However, only in older groves (31 years or over) did the operation show higher net returns per acre. He (3) is of the opinion that the value of irrigation in the older groves is due to the crowding of the trees on the land.

The results of two field experiments with regard to irrigation on citrus are available. Sites et al. (5) re-

(1) Research conducted as partial requirement for the degree of doctor of philosophy, University of Florida. The author wishes to express appreciation for the assistance given by Apshawa Groves, Inc., Clermont, Florida through its general manager, Dr. Werner Husmann. Mr. A. N. Fox and Mr. George Sanders assisted with many details.



A DAY IN THE FIELD WITH
LESTER McCLUNG

Lee J. Pearson, Auburndale grove owner and caretaker, and Gulf Field Representative Lester McClung study the fruit in a section of Mr. Pearson's grove. Mr. Pearson has been in the citrus business all of his life. He consults his Gulf Field Representative regularly and has used Gulf Brands fertilizer exclusively since 1918 in growing bumper citrus crops . . . crops that bring top income.

Yes, for "market time" satisfaction, the best growers consult their Gulf Field Representative and use Gulf Brands Fertilizer and Insecticides.

FRIENDLY GULF FERTILIZERS and pesticides

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ported inconsistent results of irrigation to several varieties on Rough lemon rootstock over a four-year period at Lake Alfred. At Haines City, with Valencia oranges and Marsh grapefruit on the same rootstock, higher yields were obtained from irrigated blocks except in one year when water was applied in November. These authors questioned whether the differences in response might be due to the fact that November irrigation was given regularly in the first instance.

In 1947 Sites (4) reported that high solids fruit was produced in years characterized by lower rainfall during the months of June, July, August, and September. Sites **et al.** (5) reported that irrigation increased juice content, but lowered the percentage of solids, acids, and Vitamin C in the juice. The resultant solids/acid ratios tended to be higher with irrigation.

Through the cooperation of Dr. Werner Husmann and his organization, Apshawa Groves, Inc., in Lake County, irrigation studies were undertaken in 1951 (6). A randomized block design with four replications was set up in a grove of Marsh grapefruit on Rough lemon rootstock planted in 1927 with 50 trees per acre.

The three treatments studied were: (A) — no irrigation, (B) — irrigation only at signs of temporary wilt, and (C) — irrigation during spring with sufficient regularity to maintain good soil moisture content at all times. Although treatment C plots were irrigated in September during the first year, thereafter no irrigation was given except during the spring months.

The emphasis upon the spring irrigation period was based upon these factors which often result in more acute water deficits in spring than is shown in other periods.

1) The dry fall months often reduce the water reserves in the soil.

2) The new growth appearing in the February-March period increases immensely the transpirational area of the tree.

3) Daily temperatures, particularly during the late March-April-May period are often high.

4) Dry southeasterly winds occur more or less constantly throughout the day during the March-April period.

5) The spring period is composed, to a large degree, of clear days with little rain and slightly lowered relative humidity. These conditions favor increases in transpiration and evaporation.

It is realized that such restriction (to the spring period) will limit the conclusions which might be drawn from the work, but it was felt that benefits might be more distinctly shown if such did occur. On each irrigation date 2½ acre-inches of lake water was applied through portable, 6-inch, perforated sprinkler pipe. The dates of treatments are shown in Table 1. In this table is also given the rainfall record of the January-June period of the particular year.

TABLE 1
Dates of Irrigation Applications by Treatment and Rainfall for Each Spring Period

Fruit Season	Treatments A	B	C	January-June Rainfall
				(inches)
1951-52	None		3 | 12 | 51	16.79
			5 | 8 | 51	
		5 | 30 | 51	5 | 30 | 51	
			9 | 11 | 51	
1952-53	None		5 | 3 | 52	21.19
		6 | 5 | 52	6 | 5 | 52	
1953-54	None	None	3 | 17 | 53	25.38
			5 | 12 | 53	
1954-55	None		4 | 26 | 54	18.06
		5 | 24 | 54	5 | 24 | 54	
			6 | 21 | 54	

An increase in cropping was apparent in all years under the irrigation treatments (Table 2). The increase for the season 1951-52, with January through June rainfall of 16.79 inches, approached significance; that for the seasons 1952-53 and 1953-54, with rainfalls of 21.19 and 25.38 inches respectively, failed to show significance; while that in 1954-55, with 18.06 inches, reached high significance. When analyzed as averages over the four

TABLE 2
Yields of Marsh Grapefruit per Tree (expressed as field boxes of 2.2 bushels)

Season	Treatments A	B	C	F value	LSD 05	LSD 01
1951-52	13.68	15.88	16.82	4.561		
1952-53	8.98	10.48	11.35	2.406		
1953-54	16.72	17.98	18.36	0.873		
1954-55	10.58	12.55	13.90	18.276**	1.355	2.052
AVERAGE	12.49	14.22	15.11	45.424**	0.683	1.035

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Florida growers now consider magnesium a primary plant food in the same category with nitrogen, phosphorus and potash.

The recommendations of the Flordia Citrus Experiment Station at Lake Alfred, published in January 1954, stress the need for large application of magnesium for Citrus in soluble form and state that it is usually applied as a Sulphate.

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years, the increases were of high statistical significance.

All irrigation treatments reduced the soluble solids content of the fruit percentagewise (Table 3). Such reductions were of significant value except for the season of high spring rainfall (1953-54). The research indicated that both total soluble solids per fruit and percentage of total solids were reduced by irrigation. There was shown to be an inverse relationship between solids and available moisture.

Irrigation treatments increased the yield in boxes per tree, but only in years of light rainfall were such increases of statistical significance. The total soluble solids per box, and the percentage of total soluble solids, were decreased by irrigation under the conditions of the study is of doubtful economic value except in

(Continued on page 23)

TABLE 3
Influence of Rainfall and Supplemental Irrigation on Percentage of Total Soluble Solids

	Dates of Maturity Tests			
	12/8/51	12/5/52	11/21/53	11/20/54
Fruit Size	96	80	96	70
Percentage of Soluble Solids				
Treatment A	9.81	9.36	7.76	8.68
Treatment B	9.49	8.94	7.77a	8.48
Treatment C	8.88	8.72	7.52	7.98
Statistical significance	**	*	n.s.	**
Rainfall in inches				
January through June	16.79	21.19	25.38	18.06

(a) Treatment B received no supplemental irrigation during the spring of 1953.

TABLE 4
Cumulative Figures of Costs and Production for the Four Years of the Study

	Treatments		
	A	B	C
Boxes per tree, for four years	49.96	56.89	60.43
Boxes per tree, for four years	2498.00	2844.50	3021.50
Increase in boxes per acre over that of Treatment A		346.50	523.50
Number of irrigation applications	0	3	11
Cost per acre for irrigation		$45.00	$165.00
Cost per box of additional boxes		$ 0.13	$ 0.315

Commercially, the cost of irrigation at an estimate of $15.00 per acre-2½ inches must be calculated. Over the four-year period three applications were made under Treatment B and eleven under Treatment C. Table 4 shows that the additional fruit under Treatment B cost 13c per box, while the increased production of Treatment C was made at a cost of 31.5c per box.

It would appear that irrigation will pay as a commercial operation when water is applied at the first indication of a temporary wilt during the spring period. It would further appear that the need for water is most pronounced when less than 20 inches of rainfall occurs during the January through June period. There may be further benefit from irrigation, which could not be ascertained during the course of this work. That is the possible benefit which might occur during the prolonged drought — a condition which was not present at any time during the study.

SUMMARY

Field irrigation studies were conducted on Lakeland fine sand planted to Marsh grapefruit on Rough Lemon rootstock over four crop years.

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Reports Of Our Field Men . . .

EAST HILLSBOROUGH AND PASCO COUNTIES

E. A. McCartney

Since the last report on this territory we have had, as most other sections in the state, all kinds of weather and most of it bad. As of this date citrus has not been hurt but has benefited by the cold weather and is moving in heavy volume. Rust mite, some red spider and continued winds has caused heavy leaf dropping in most of this territory, especially in the Plant City section. Some young trees have been killed in low sections but in the main, citrus fruit and trees have come through with little damage.

The vegetable farmers were hurt bad and a few early planted mellons were killed. Cold weather and the Christmas holidays slowed up fertilizer deliveries but at this time it has warmed up and we are getting ready for the spring application of Top Dresser. Hope the serious cold weather has passed us up.

SOUTH HILLSBOROUGH AND MANATEE COUNTIES

J. D. Toll

During the past month Old Man Weather reminds us that he's still boss.

Generally, the tender growth on young citrus groves was killed by the cold. Older groves, particularly where the soil lacked sufficient moisture, had a lot of leaf drop and burned foliage caused by the strong cold winds.

A lot of tender vegetable crops such as pepper and squash were killed.

In the Ruskin, Palmetto and Bradenton areas the spring tomato crop which was approximately 1 to 3 inches high got by with moderate damage.

The strawberry crop in the Plant City area was also damaged. The bloom and some berries were killed and the older berries slow to mature.

Now, on the brighter side — Citrus has been bringing a good price. Also, the tomato market looks good. Another thing, spring and warm weather are just around the corner, I hope.

By the time you read this the spring fertilizer application on citrus will have begun.

HIGHLANDS AND POLK COUNTIES

J. K. Enzor, Jr., & R. E. Lassiter, Jr.

We have been receiving quite a lot of "firing" and leaf drop in this area during the past month. While purple mites have taken most of the blame for this damage, dry desiccating winds have also played a very important role in the leaf drop. We have found cases where rust mites have also been a factor in the amount of "firing."

Rust mite and purple mite should be controlled wherever present regardless of the tree condition where leaf drop has occurred. Mites will concentrate on leaves that have not dropped and further leaf drop is likely if mites are not controlled.

The orange prices for mid-season varieties have been good and growers are quite pleased with the prospect of good prices for their Valencia crops.

As yet we have not seen any cold damage done to citrus except in young blocks where young tender growth was present.

Growers are beginning to be concerned with their spring fertilizer application and we expect to start this application in the next few weeks.

SOUTH POLK, HIGHLANDS, HARDEE, DeSOTO AND SARASOTA COUNTIES

C. R. Wingfield

The month of January has been a very trying and hazardous period. First from the East and then from the Northwest. The East winds bringing about a leaf damage which no doubt was aided by weakened foliage due to rust mite and/or red spider, and all of this on top of a general drought we have had for some time. The Northwest winds were bitting cold and in a period of calm in the early morning there was frost that almost equaled a light snow. Along with kind of weather came temperatures reported as low as 26 degrees. Fortunately it did not stay at this figure very long but it was long enough to destroy most tender vegetable crops. Citrus damage was comparatively light and can be confined to tender growth on young trees. There is a lot of leaf drop and no doubt comes from this weather condition.

Fruit movement has been very heavy up to the time of this writing (16th) to the juice plants and unsold crops are hard to find. Prices have been satisfactory and promise to continue into the Valencia picking period. There has been a heavy fruit drop especially in grapefruit and in oranges where there have been twig damage from either cold winds or frost.

The Spring vegetable crop planting will be under way at this publication if weather will permit. Lands have been prepared but any estimate of the crop variety cannot be determined at this time.

NORTH CENTRAL FLORIDA

V. E. Bourland

Weather has been very cold with high north winds, but so far doesn't seem that too much damage has been done to fruit. Practically all truck crops have been killed. All young trees have been banked, but where there was any new growth it has been damaged by cold in most groves. Pastures are brown as result of frost. Oranges are being picked as fast as possible, all mid-season oranges have been sold or placed, prices are satisfactory to growers.

WEST HILLSBOROUGH AND PINELLAS COUNTIES

J. A. Hoffman

The severe cold weather during January did very little damage to fruit trees thorughout this section, although some fruit was hurt. Young trees planted in low pocket areas received considerable damage. Drying cold winds combined with rust mite and purple mite have caused a lot of leaf droppage throughout most of Pinellas and West Hillsborough Counties.

Some growers started irrigating about the middle of January and are planning on applying a good quality top dresser in February.

Melon growers in this section had their fields ready for planting the first of January, but held off planting until after the cold spell. Planting started about the 17th of January.

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Uncle Bill Says:

We always git a kick out of these here fairs they have in Florida . . . in Tampa, in Winter Haven, in Orlando, and in a lot of other good towns where agriculture is a purty important business every year all us home folks and thousands of visitors who are in our state at this season of the year can see what us farmers and grove owners is doing to supply the world with the best fruits and vegetables that is grown anywhere.

And it seems like every year the exhibits which is shown at these places git bigger and better . . . which is natural in view of the steady progress which is bein' made all the time in producin' bigger and better crops.

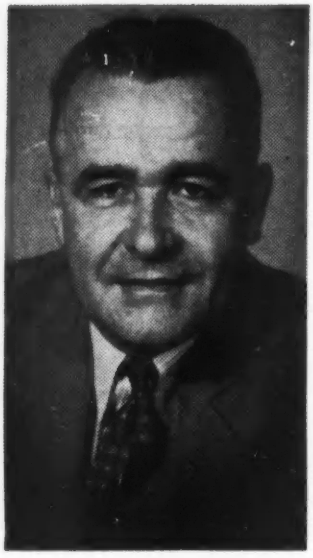
They is a lot of other things which these fairs show people, like new electric gadgets, new kinds of all sorts of machinery, 'n hosts and hosts of other things . . . not forgettin' the auto races 'n free acts in front of the grandstands . . . all of which sort of helps remind us that things change and improve as time goes by.

All this is mighty fine and we like to see these exhibits . . . but gettin' right down to earth we git jist as big a kick out of seein' a fine grove or a fine field where fruit and vegetables is gittin' ready to supply the world with appetizin' eatin'.

After everything is said'n done it's purty hard to improve on nature . . . 'n while scientists undoubtedly has helped Nature in the job she's doin' it still takes the soil, the sun and the rain to do their full share in producin' the finished product.

'n probably the biggest single thing which has helped Nature improve her crops is fertilizer, fer as everyone knows the ingredients originally placed in the soil has got to be replenished as they're used up and that's what good fertilizer does, as well as providin' the plants 'n trees with a lot of food elements which feeds these crops 'n trees . . . and as we've said many times it has been proven to us over the years that Lyons Fertilizers Produce Maximum Crops of Finest Quality.

Florida Citrus Mutual Names New Officers



VERNON L. CONNER

G. F. WARD

At its annual meeting in Lakeland on January 13 Florida Citrus Mutual elected Vernon L. Conner, prominent Mount Dora citrus grower, as president, succeeding the late Perry Murray who was recently killed in an automobile accident near his home at Frostproof. At the same time the big organization elected G. F. Ward, Avon Park nurseryman, as secretary, succeeding Mr. Conner who had long held that position. Both men have long been prominent in Florida citrus circles and active in the affairs of the giant citrus cooperative.

Marketing Survey Of Frozen Grapefruit Sections . . .

Frozen grapefruit sections, when offered in retail stores, appeared to add to the total demand for grapefruit, a market test by the U. S. Department of Agriculture indicates. This is a relatively new grapefruit product.

This observation is based on findings in a retail store audit and a household survey conducted during a market test in Erie, Pa., August to November, 1954, in cooperation with the Florida Citrus Commission. The test was designed to help the citrus industry determine whether this is a feasible form in which to market grapefruit and to learn the effects of various types of promotional activities. The promotional program, conducted by the Florida Citrus Commission, included advertising the frozen sections by newspaper, radio, television, displays, and distribution of samples in the larger chain and independent stores in Erie.

During the 11-week test period, almost 1,300 cases of 24 10-ounce cans were sold. Two-thirds of the sales were made during the 4-week promotional period. Stores featuring demonstrations with samples sold four times as many cases as comparable non-demonstration stores. Impulse sales created by the promotions undoubtedly acquainted new customers with the product and should enlarge the total market, the researchers concluded.

During the test period, sales of frozen grapefruit sections were second only to frozen strawberries, when compared with other frozen fruits. Sales were about the same as those of canned grapefruit sections kept on the shelf.

From the household survey it was determined that about half the homemakers interviewed were aware of the new product, and two in 10 had bought it. About eight out of 10 of those who had bought were pleased by its natural flavor and freshness. Some thought the product was too sweet, some thought the can too small. At least one processor has

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modified his pack as a result of these findings.

A copy of Marketing Research Report No. 110, "Frozen Grapefruit Sections: Evaluating a New Product by Retail Sales Audit and Household Survey," may be obtained from the Marketing Information Division, Agricultural Marketing Service, U. S. Department of Agriculture, Washington 25, D. C.

IRRIGATION STUDIES WITH MARSH GRAPEFRUIT ON LAKELAND FINE SAND IN CENTRAL FLORIDA . . .

(Continued from page 29)

those years (1951-52; 1954-55) with low spring rainfall. Injudicious use of irrigation may increase costs of production and reduce quality of fruit.

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USDA Issues Standards For Grades Of Dehydrated Orange Juice . . .

The U. S. Department of Agriculture has issued United States Standards for grades of dehydrated orange juice. The standards were developed at the request of processors and users of the product. The grades are U. S. Grade A or U. S. Fancy; U. S. Grade B or U. S. Choice, and Substandard.

The standards apply to a granular product which has been reduced to less than 3 percent moisture and packaged with a desiccant to reduce further the moisture content. The product reconstitutes to the equivalent of single-strength orange juice by the addition of a specified amount of water.

The quality of the product is evaluated principally on color, absence of defects, and flavor of the reconstituted juice. It is the first issuance of grade standards for this product.

Other important requirements for Grade A are a Brix-acid ratio of not less than 12 to 1 nor more than 18 to 1 and a recoverable oil content of not less than 0.006 nor more than 0.012 ml. per 100 ml. of the reconstituted juice. Comparable Grade B requirements are a Brix-acid ratio of not less than 10.5 to 1 nor more than 19 to 1 and a recoverable oil content of not less than 0.004 nor more than 0.020 ml. per 100 ml. of the reconstituted juice.

The standards became effective on publication in the Federal Register on January 27, 1956, in order that they may be used in marketing current production. They are essentially the same as those proposed by the Department on November 20, 1955.

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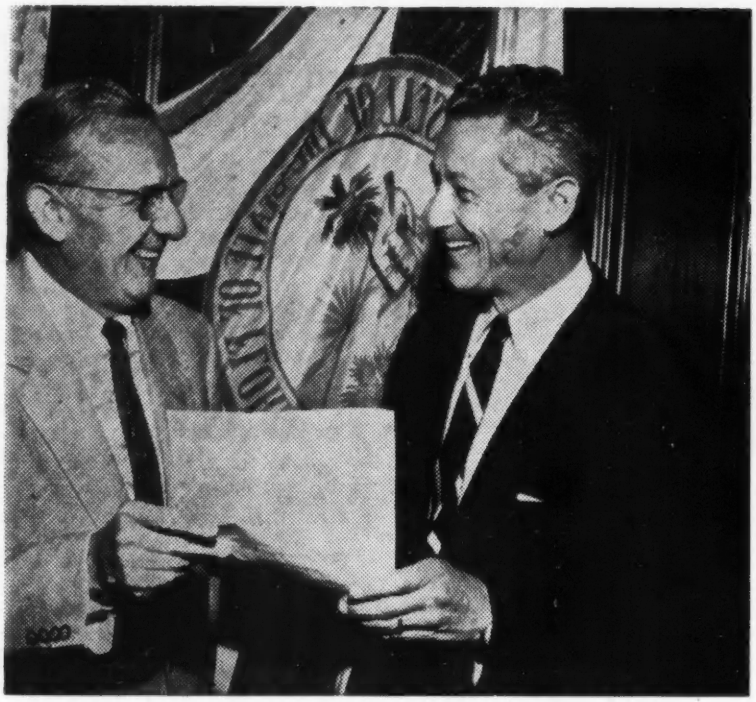
INDEX TO ADVERTISERS

Berkshire Chemicals Co.	28
Baughman Mfg. Co., Inc.	23
John Bean Sprayers (Food Machinery & Chem. Corp.)	22
Collier & Young, Inc.	34
Food Machinery & Chem. Corp.	24
Florida Favorite Fertilizer	33
Glen St. Mary Nurseries Co.	13
Gulf Fertilizer Co.	27
Haven Mill Supply	29
The Hardie Mfg. Co.	25
International Min. & Chem. Corp.	5
Jackson Grain Co.	15
Lake Garfield Nurseries Co.	2
Lyons Fertilizer Co.	30-31
Lyons Fertilizer Co.	36
Frank M. Murphy & Associates	4
Naugatuck Chemical Co.	35
Pounds Tractor Co.	6
Palmer Nurseries	29
Peninsular Telephone Co.	32
Snively Groves, Inc.	19
Swift & Co.	17
Southern Dolomite Co., Inc.	23
Southland Supply Co., Inc.	23
Carroll Smith Hdw. Co.	24
Superior Fertilizer Co.	32
Southern Pipe & Supply Co.	26
Winter Haven Herald	26
Winter Haven News-Chief	29
Wilson & Toomer Fertilizer Co.	8

HEARING TO CUT CITRUS FREIGHT RATES, FEB. 15

A hearing will be held in New York Feb. 15 on a proposal to cut Florida citrus shipping rates to Buffalo, Cleveland and Detroit by about 20 per cent.

Southern railroads have agreed to the rate cut, but to become effective they must be approved also by Eastern railroads.



Governor Leroy Collins here presents Ray Krakow, left, of Tampa, a copy of a proclamation proclaiming February 19-25 as National Advertising Week in Florida. Krakow is Fourth District chairman of the planned observance.

BURGESS NEW CHIEF U. S. D. A. PLANT PEST CONTROL BRANCH

Emory D. Burgress has been appointed chief of the Plant Pest Contral Branch of the U. S. Department of Agriculture, it was announced by Dr. Byron T. Shaw, administrator of the Department's Agricultural Research Service.

Mr. Burgess, who been assistant chief of plant pest control work since 1954, succeeds Dr. W. L. Popham as Branch chief. Dr. Popham was recently made director of crops regulatory programs for the Department.

In his new position, Mr. Burgess will direct cooperative programs for control or eradication of such native insects as the grasshopper and Mormon cricket, foreign pests such as the golden nematode, khapra beetle, and Mexican fruit fly, and plant diseases such as black stem rust or wheat, phony-peach disease, and peach mosaic. He will supervise technical assistance furnished to foreign countries by the Department for control of locusts (grasshoppers) and other insects. His Kranch is also responsible for registering pesticides and regulating their labeling. The Brance's weekly cooperative economic insect survey report keeps the public informed of the abundance and distribution or harmful insects throughout the Nation.

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Order Aramite from your local supplier today. Write, wire or phone us if unable to locate immediate source of supply.

SEE – Naugatuck Chemical Division, United States Rubber Company, at work on NBC's "Color Spread" TV spectacular, Sunday, March 25, 7:30 PM, EST.

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